TECHNICAL PROGRESS REPORT NO. 144 JULY 1965

An Evaluation of Herbicides for Use with Cucumbers (*Cucumis sativus*) and Watermelons (*Citrullus vulgaris*) in Hawaii

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ACKNOWLEDGMENTS

Thanks are extended to Dr. Donald L. Plucknett, Superintendent of the Kauai Branch Station, and to Mr. Noboru Kanda and Mr. Herbert Waki, Superintendents of the Poamoho and Waimanalo Experimental Farms, respectively, for their valuable assistance in conducting the field trials. The technical assistance of Mr. Henry C. Oshiro was greatly appreciated and the helpful suggestions from Mr. Yukio Nakagawa, Associate Specialist in Horticulture, Hawaii Cooperative Extension Service, were invaluable.

The herbicides used in the trials were generously supplied through the courtesy of the Dow Chemical Company; United States Rubber Company, Naugatuck Chemical Division; Niagara Chemical Division of FMC Corporation; Monsanto Chemical Company; and Standard Oil Company in Honolulu.

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An Evaluation of Herbicides for Use with Cucumbers (*Cucumis sativus*) and Watermelons (*Citrullus vulgaris*) in Hawaii

R. R. Romanowski, Jr.,[1] and J. S. Tanaka[2]

INTRODUCTION

Cucumbers and watermelons are two important cash crops grown in the Islands. All of the cucumbers and approximately 60% of the watermelons consumed in the State are grown locally. Weeds are one of the major problems confronting the grower of vine crops, especially after a dense vine ground cover allows little or no tillage with farm implements. The herbicide trials reported herein were designed to determine the crop tolerance and weed response to herbicides registered by the Federal Food and Drug Administration for use in the United States. The trials were conducted to study the efficacy of the herbicides at three experiment stations located near the major producing areas.

MATERIALS AND METHODS

The general experimental procedures consisted of the field application of herbicides immediately after seed sowing and again approximately 4 to

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6 weeks after sowing when the initial treatments were no longer effective. The treatment applications at 4 to 6 weeks, commonly referred to as vining time, were especially important for this is the last date that farm implements can be used to remove weeds. It was postulated by the authors that the suggested use in temperate regions of applying herbicides over the entire crop area at vining may result in crop phytotoxicities under tropical and subtropical conditions.

Herbicide Experiments and Locations:

Experiment No.	*Crops*	*Location*
1	Cucumber (Burpee's Hybrid)	Kauai Branch Station, Kauai
2	Cucumber (Burpee's Hybrid and University of Hawaii breeding line 59-H-11)	Waimanalo Experimental Farm, Oahu
3	Cucumber (Burpee's Hybrid)	Waimanalo Experimental Farm, Oahu
4	Cucumber (59-H-11) and Watermelon (Charleston Gray)	Waimanalo Experimental Farm, Oahu
5	Watermelon (Charleston Gray)	Waimanalo Experimental Farm, Oahu
6	Watermelon (Charleston Gray and Black Seeded Chilean)	Waimanalo Experimental Farm, Oahu
7	Watermelon (Black Seeded Chilean)	Poamoho Experimental Farm, Oahu
8	Watermelon (Charleston Gray and Black Seeded Chilean)	Poamoho Experimental Farm, Oahu

Treatment Application

The herbicides were applied immediately after seed sowing and in some treatments again at vining. Spray formulations were used shortly after seed sowing and either spray or granular formulations were broadcast over the entire plot area at vining. A back-mounted sprayer was used to apply the spray applications and the granular formulations were applied

with either a hand cyclone seeder or a hand-operated Gandy applicator. All liquid formulations were sprayed at 30 p.s.i. (pounds per square inch of pressure) and 40 gal/acre (gallons per acre) of solution.

The herbicides were used before any weeds appeared above the soil surface. Cultivation was used where necessary to remove any weeds which were prevalent at the time of herbicide application. Rates of chemicals are reported in pounds of active ingredient per acre throughout this report.

Cultural Practices

Furrow irrigation was applied when necessary in Experiments 2 to 8. The seeds were sown on furrow slopes approximately 2 to 4 inches from the furrow bottom to conform with a practice commonly in use by island farmers. Hereafter, the term "furrow" shall be used to designate the entire furrow area and "shoulder" to describe the level area between furrows.

A "cultivated check" treatment was maintained in a majority of the experiments by removing the weeds at frequent intervals. All other treatments were weeded when necessary before a weed × crop interaction was anticipated. The remaining cultural practices conformed to the latest recommendations issued by the Hawaii Cooperative Extension Service.

Methods of Evaluating and Reporting the Experimental Results

In addition to objective methods of measurement the following subjective weed control and crop tolerance rating systems were recorded:

Weed Control Ratings	*Crop Tolerance Ratings*
1 no control	1 no injury
2 slight control	2 slight injury
3 fair control	3 moderate injury
4 good control—commercially acceptable	4 severe injury
5 complete control	5 dead

The procedure for the subjective measurements was to study all of the checks in an experiment before the ratings were made. Subsequently, all plots were rated without knowledge of the treatments applied. Because of variable weed stands and varied crop-plant growth, the treatment means presented in this report often deviate from a rating of "1" for the check plots.

All data are reported in the Appendix as treatment means. The L.S.D. (least significant difference) was selected as the main statistic for ease of comparing treatment means. It was used largely to compare the herbicide treatment means to the cultivated check when considering crop tolerance and to the uncultivated check when interpreting weed response. The data are presented in Appendix form to allow for careful scrutiny by interested parties. It is assumed that the General Results and Discussion sections will provide ample information for many users of this report.

List of Chemicals Used in the Experiments

Trade Name[1]	*Temporary Designation or Common Name*	*Chemical Name*
Alanap-3	NPA—sodium salt	Sodium N-1-Naphthyl phthalamate
Dowicide-7	PCP	Pentachlorophenol
Dowicide-G	PCP—sodium salt	Sodium Pentachlorophenate
Sinox PE	DNBP, amine	4,6-dinitro-2-s-butylphenol (Triethanolamine salt)
Vegadex	CDEC	2-chloroallyl NN-diethyldithio-carbamate
55 AR oil		Aromatic oil (Standard Oil Co.)

[1]Active ingredients of chemical formulations: Emulsifiable concentrates (pounds per gallon) Alanap-3 2 lb.; Sinox PE 3 lb.; and Vegadex 4 lb. Wettable Powders—Dowicide-7 96% and Dowicide-G 90%. Granulars—Alanap-3 10.8%.

Scientific Names of the Weed Species Discussed in this Report

COMMON NAME (Hawaiian Islands)	*SCIENTIFIC NAME*
Grasses	
lovegrass	*Eragrostis pectinacea*
sandbur	*Cenchrus echinatus*
wiregrass	*Eleusine indica*
Broadleaves	
amaranth, spiny	*Amaranthus spinosus*
amaranth (spineless species)	*Amaranthus spp.*
pualele, red; flora's paint brush	*Emilia sonchifolia*
pualele, orange	*Emilia coccinea*
jamaica vervain	*Stachytarpheta jamaicensis*
popolo, black nightshade	*Solanum nigrum*
pigweed (purslane)	*Portulaca oleracea*
richardia	*Richardia scabra*
sow thistle	*Sonchus oleraceus*
spanish needle	*Bidens pilosa*
spurge, garden	*Euphorbia hirta*
spurge, graceful	*Euphorbia glomerifera*
swinecress	*Coronopus didymus*
tarweed	*Cuphea carthagenensis*

RESULTS

The crop and weed response to the herbicides varied considerably when the results were reviewed in their entirety. Nevertheless, valuable information was obtained which can be used in an attempt to aid in explaining some of the erratic results experienced by growers. The following results are summarized from the experimental data contained in the Appendix: (Alanap-3 was used as the standard herbicide since it is recommended throughout the United States for weed control with the crops under test.)

Alanap-3

Cucumber tolerance—The cucumbers were tolerant to Alanap at the 3 to 4 lb/acre (pounds per acre) rate in all of the experiments when used immediately after seed sowing. Sizeable yield reductions were obtained in Experiment No. 2 when the herbicide was applied as the cotyledons were breaking through the soil surface. The granular formulation resulted in less injury when used at vining than the spray formulation. This was especially noticeable during the growing cycle in that the plants receiving the liquid sprays exhibited leaf burn and chlorosis.

Watermelon tolerance—Unlike the cucumbers, Alanap did not appear to be as safe on watermelons when used at sowing. Although the plants survived in all experiments, attention should be given to the almost consistent reductions in vine lengths and final yield estimates in three of the five experiments. Experiments No. 6 and 8 showed no injury to watermelons from Alanap when used at sowing; however, it should be noted that essentially no precipitation occurred for 2 or more weeks after treatment. The spray application applied at vining was more injurious than the granular formulation in only one of four experiments.

Weed control—The broadleaved weed species were controlled satisfactorily in six of eight experiments and the grasses in three of seven experiments for a period of 4 to 6 weeks. The poorest over-all weed control was experienced in Experiments No. 6 and 8, which received low initial rainfall. The most prevalent grass species were wiregrass and sandbur, whereas spiny and smooth amaranth spp., purslane, and popolo were the most common broadleaved weeds.

PCP

Watermelon tolerance and weed control—Pentachlorophenol was used in an oil + water + emulsifier mix in Experiment No. 6 shortly after seed sowing. No injury to the watermelon growth was detected and the resultant residual weed control was poor. The poor weed results were anticipated in that, the above mix is used as a contact herbicide and exhibits essentially no preemergence activity. Crop phytotoxicity was of primary consideration in designing the treatment.

PCP, (sodium salt)

Cucumber tolerance—Sodium pentachlorophenate caused no crop injury when applied immediately after sowing, but complete eradication of the cucumbers resulted when used at comeup in Experiment No. 2.

Watermelon tolerance—This herbicide resulted in no injury to watermelons when used immediately after the seeds were sown. On occasion, a slight cupping of the cotyledons was detected.

Weed control—Sodium pentachlorophenate was superior to Alanap in one test and was equal to or exhibited poorer weed control in five tests. Sodium pentachlorophenate did not give commercially acceptable control of the primary grasses, wiregrass and sandbur, in a majority of the experiments when used preemergence to the weeds.

Sinox PE

Crop tolerance—Sinox PE was tested in two trials on cucumbers. The recommended cleared rate of 3 lb/acre did not cause crop injury; however, a 4 lb/acre rate showed a slight reduction of growth in Experiment No. 4. Also, Experiment No. 4 showed that Sinox PE resulted in slightly shorter vine growth when applied over the watermelon rows after sowing.

Weed control—Sinox PE exhibited only fair weed control at the rates used and was not as effective as Alanap. It is known that higher rates of Sinox PE 6 lb/acre will provide commercially acceptable weed control in the Islands, but fear of crop phytotoxicity and lack of Food and Drug Administration registration at the higher rates prevents its use.

Vegadex

Cucumber tolerance—Vegadex reduced the early cucumber yield in two of four experiments and the final total yield in

one of the four experiments. The data clearly indicate that the 4 lb/acre rate should not be exceeded when Vegadex is used as a preemergence herbicide for cucumbers.

Watermelon tolerance—Although not registered for use with this crop, Vegadex appeared relatively safe when used at the 4 and 6 lb/acre rates in two experiments.

Weed control—The weed control with Vegadex at the 4 lb/acre rate was somewhat comparable to Alanap at the same rate in most experiments. Alanap controlled popolo slightly better than Vegadex; nevertheless, both were somewhat similar in the control of purslane, amaranth spp., and grasses under the test conditions.

DISCUSSION AND SUMMARY

The results showed that Alanap-3 is acceptable for *trial use* as a cucumber and watermelon herbicide in Hawaii. However, it was clearly shown that erratic results can be expected in its use under the many varied conditions confronting the island farmers. Some of the following suggestions are made to increase its efficient use based on the experimental results: For the initial application, Alanap should be applied at 3 to 4 lb/acre *immediately* after sowing the seed. If overhead irrigation is available, the treated area should be watered with ½ acre-inch of water. Caution should be used when trying Alanap for the first time on watermelon plantings under island conditions. Only the granular formulation should be used when treating cucumbers at vining. This formulation is also preferred but not as necessary when treating watermelons. If a heavy grass infestation prevails on a farm, preparations should be made to use standard cultural weed practices to remove a potential weed population. All of the weeds appearing above the soil surface should be removed before retreatment with Alanap at vining.

Sodium pentachlorophenate can be used as a herbicide for cucumbers and watermelons at 17 to 22 lb/acre if applied immediately after seed sowing. It would be particularly advantageous if small weeds were already present at sowing time. Extreme caution must be used when applying the herbicide because the drift is extremely irritating and potentially dangerous if precautionary measures are not considered by the user. There are only a limited number of situations where adequate tractor equipment is available in the Islands for the application of this herbicide.

Vegadex can be used for cucumbers at the 3 to 4 lb/acre rate immediately after seed sowing. Caution should be exercised so as not to exceed the 4 lb. rate because crop injury may result. Alanap is preferred to Vegadex because of its safer crop tolerance, but there are undoubtedly certain situations where Vegadex will result in superior weed control.

Sinox PE at the cleared rate of 3 lb/acre for cucumbers is of questionable use in the Islands as a preemergence herbicide. Similarly, pentachlorophenol at the 4 lb/acre rate used as a mix with oil has limited application. These two herbicides could conceivably be used if the seeds were sown in a soil which already had small weeds appearing above the soil surface, because both herbicides exhibit satisfactory contact action on small weeds. Care would have to be used not to exceed the 3 lb. rate with Sinox PE. Both weedicides should be applied immediately after seed sowing so as to prolong the interval from herbicide application to crop-seed germination.

The experimental results showed that Alanap should be considered as the primary herbicide for use with cucumbers and watermelons. However, the results clearly show that Alanap does perform erratically in the Islands; therefore, poor weed control may be experienced on certain soils under certain climatic conditions. Evidence was also presented to show that a herbicide is needed for island use which would be more efficient under dry conditions since most cucumbers and watermelons are grown where furrow irrigation is practiced. Finally, a herbicide is needed which could be used to supplement the existing herbicides for grass control.

APPENDIX

EXPERIMENT NO. 1

(Permanent file copy WC-13B)
Cucumber Trial
Kauai Branch Experiment Station Field D

Cucumber hybrid:	Burpee's Hybrid.
Soil:	Halii gravelly silty clay.
Experimental design:	Randomized complete block, 3 replications, plot size 10 ft. × 20 ft. (5 hills).
Experimental procedure:	Field preparation May 2, 1962; Seed sown May 3; Treatment application May 3.
Climatic conditions:	*Rainfall (over .10 inch):* May 3–.20 inch, 4–.26, 7–1.17, 8–.36, 9–.12, 10–.36, 13–.13, 15–.43, 16–1.30, 17–.35, 18–.22, 19–.17, 20–.14.
	Irrigation: No supplemental irrigation.
Weed species:	Most prevalent: *broadleaves*–popolo, flora's paint brush, and orange pualele.
	Trace amounts: *broadleaves*–graceful spurge, sow thistle, jamaica vervain, and tarweed.
Results:	See table 1-1. Cucumber tolerance and weed control response to the herbicides, Kauai Branch Station, Experiment No. 1.

Discussion and Summary:

Cucumber tolerance–Alanap-3, Vegadex, and Na PCP did not injure the cucumbers.

Weed control–Alanap-3 was superior in weed control to Vegadex and Na PCP. The weed control experienced with Alanap was especially important in that the broadleaved weed species prevalent in this trial are resistant to most vegetable herbicides.

Table 1-1. Cucumber tolerance and weed control response to the herbicides, Kauai Branch Station, Experiment No. 1

Treatment (pounds per acre)	Total Yield (pounds per plot)	Weed Rating[1] (June 1)
1. Check	82.7	1.3
2. Alanap 3 lb.	84.8	4.0
3. Alanap 4 lb.	81.7	4.3
4. Vegadex 4 lb.	78.0	3.0
5. Vegadex 6 lb.	88.3	3.0
6. Na PCP 17 lb.	85.2	1.7
L.S.D. 5% (1%)	n.s.	1.0 (1.4)

[1]Weed rating scale: 1–no control, 2–slight, 3–fair, 4–good (commercially acceptable), 5–complete control.

EXPERIMENT NO. 2

(Permanent file copy WC-10)
Cucumber Trial
Waimanalo Experimental Farm Field R-1

Cucumber hybrid and Breeding line: Burpee's Hybrid and University of Hawaii Breeding line 59-H-11.

Soil: Waimanalo silty clay.

Experimental design:	Randomized complete block, 4 replications, plot size 8 ft. × 20 ft. (5 hills). Factorial arrangement of treatments–2 varieties × 13 formulations.
Experimental procedure:	Field preparation April 3, 1962; Seed sown April 5; Treatment applications–Preemergence to the crop (some cotyledons breaking soil surface) April 9, postemergence to crop at vining May 4.
Climatic conditions:	*Rainfall (over 10 inch):* April 10–.36 inch, 15–.72, 16–.12, 18–.18, 19–.13, 26–.96, May 3–.11, 4–.17, 5–.41, 6–1.03, 8–.21, 15–.37.
	Irrigation: Furrow irrigated on April 4, 13, 23, 30, and May 21.
Weed species:	Most prevalent: *grasses*–wiregrass, sandbur; *broadleaf*–spiny amaranth.
	Trace amounts: *broadleaves*–sow thistle, garden spurge, purslane.
Results:	See table 2-1. Cucumber tolerance and weed control response to the herbicides, Waimanalo Experimental Farm, Experiment No. 2.

Discussion and Summary:

Cucumber tolerance–Burpee's Hybrid and University of Hawaii Breeding line 59-H-11 responded similarly to the herbicide treatments. No significant interaction was found between crops and formulations. All of the treatments resulted in a reduction in the number and weight of fruits per plot when compared to the cultivated check. The crop damage may have resulted primarily from the late herbicide application at time of plant germination. This was undoubtedly true of the Na PCP treatments.

Weed control–All chemicals exhibited commercially acceptable weed control on the broadleaved species. Na PCP was the least effective on wiregrass and sandbur when compared to the commercially acceptable control obtained with Alanap-3 and Vegadex.

Table 2-1. Cucumber tolerance and weed control response to the herbicides, Waimanalo Experimental Farm, Experiment No. 2

Treatment (pounds per acre)	Yield Data (May 21 plus May 23)				Weed Control Rating[1] on shoulders (May 3)	
	No. of fruits/plot		Weight of Fruits (pounds per plot)			
	Burpee's Hybrid	59-H-11	Burpee's Hybrid	59-H-11	Grasses	Broadleaves
1. Check, uncultivated	9.8*	6.3**	6.6	3.8**	1.1	1.1
2. Check, cultivated	16.8	18.3	10.1	12.9	4.0	4.5
3. Alanap 2 lb.	12.0	9.3**	7.5	5.7**	3.9	4.0
4. Alanap 3 lb.	10.5*	6.8**	7.7	3.8**	4.1	4.5
5. Alanap 4 lb.	6.5**	9.8**	4.1**	6.1**	4.1	4.6
6. Na PCP 14 lb.	0.0**	1.3**	0.0**	0.7**	3.6	4.3
7. Na PCP 17 lb.	0.0**	0.8**	0.0**	0.4**	3.5	4.0
8. Vegadex 4 lb.	10.0*	12.0*	6.3	7.6*	4.3	4.1
9. Vegadex 6 lb.	8.0**	10.0**	4.8*	5.6**	4.4	4.3
10. Treatment No. 5 + Alanap 3 lb. spray at vining	7.8**	9.8**	5.1*	6.2**	4.4	4.8
11. Treatment No. 5 + Alanap 4 lb. spray at vining	4.3**	6.0**	2.4**	2.3**	4.3	5.0
12. Treatment No. 5 + Alanap 3 lb. granular at vining	13.8	12.5*	8.5	7.2**	4.4	4.8
13. Treatment No. 5 + Alanap 4 lb. granular at vining	6.8**	9.0**	3.8**	5.5**	3.6	4.5
L.S.D. 5% (1%)	5.6(7.5)	5.6(7.5)	4.1(5.5)	4.1(5.5)	0.6(0.8)	0.5(0.7)

[1]Weed rating scale: 1–no control, 2–slight, 3–fair, 4–good (commercially acceptable), 5–complete control.

*Significantly different from the cultivated check at the 5% level (**1% level).

EXPERIMENT NO. 3

(Permanent file copy WC-25)
Cucumber Trial
Waimanalo Experimental Farm Field C-2

Cucumber hybrid:	Burpee's Hybrid.
Soil:	Waimanalo silty clay.
Experimental design:	Randomized complete block, 4 replications, plot size 5 ft. x 20 ft. (8 hills).
Experimental procedure:	Field preparation October 25, 1962; Seed sown October 26; Treatment applications—Preemergence to the crop October 27, postemergence to the crop at vining November 20.
Climatic conditions:	*Rainfall (over .10 inch):* December 3—.10 inch, 10—.30, 13—1.63, 14—1.66, 17—2.00, 20—.23.
	Irrigation: Furrow irrigated on October 26, 31, November 9, 14, 19, 21, 26, 30, December 10.
Weed species:	Most prevalent: *grasses*—wiregrass, sandbur; *broadleaves*—spiny amaranth, popolo, purslane, swinecress, and garden spurge.
Results:	See table 3-1. Cucumber tolerance and weed control response to the herbicides, Waimanalo Experimental Farm, Experiment No. 3.

Discussion and Summary:

Cucumber tolerance—Vegadex applied at sowing caused a reduction in yield for the first two harvests, but the final yield was equal to the cultivated check treatment. Alanap applied as a liquid spray at vining caused leaf chlorosis and a reduction in yield of the first two harvests compared to no injury when a granular form of the herbicide was used at vining.

Weed control—Alanap and Vegadex provided commercially acceptable weed control, whereas Sinox PE was not acceptable at the 3 lb/acre rate.

Table 3-1. Cucumber tolerance and weed control response to the herbicides, Waimanalo Experimental Farm, Experiment No. 3

Treatment (pounds per acre)	Yield Data (pounds per plot)		Weed Control Rating[1] (Nov. 21)	
	Dec. 14 plus Dec. 17 (first 2 harvests)	Total Yield	Grasses	Broad-leaves
1. Check, uncultivated	4.6	19.3	1.0	1.0
2. Check, cultivated	5.7	21.2	3.3	3.3
3. Alanap 3 lb.	3.9	24.8	5.0	5.0
4. Alanap 4 lb.	5.0	22.9	4.8	5.0
5. Vegadex 4 lb.	3.4*	22.9	4.3	4.8
6. Vegadex 6 lb.	3.3*	21.0	4.0	4.8
7. Treatment No. 4 + Alanap 4 lb. liquid at vining	2.1**	14.4	5.0	5.0
8. Treatment No. 4 + Alanap 4 lb. granular at vining	4.4	22.7	5.0	5.0
9. Sinox PE 3 lb.	5.8	24.8	3.0	3.8
L.S.D. 5% (1%)	2.0(2.7)	n.s.	0.6(0.8)	0.7(0.9)

[1]Weed rating scale: 1—no control, 2—slight, 3—fair, 4—good (commercially acceptable), 5—complete control.

*Significantly different from the cultivated check at the 5% level (**1% level).

EXPERIMENT NO. 4

(Permanent file copy WC-1)
Cucumber and Watermelon Trial
Waimanalo Experimental Farm Field C-3

Breeding line and variety:	University of Hawaii cucumber breeding line 59-H-11 and watermelon variety Charleston Gray.
Soil:	Waimanalo silty clay.
Experimental design:	Randomized complete block, 4 replications, plot size 5 ft. × 20 ft. (4 hills). Factorial arrangement of treatments—2 crops × 10 formulations.
Experimental procedure:	Field preparation November 24, 1961; Seed sown November 27; Treatment applications—November 28.
Climatic conditions:	*Rainfall (over .10 inch):* December 5—.48 inch, 6—.45, 8—.28.
	Irrigation: Furrow irrigated once weekly when necessary.
Weed species:	Most prevalent: *grass*—wiregrass; *broadleaves*—spiny amaranth, popolo.
	Trace amounts: *broadleaves*—purslane, smooth amaranth spp., garden spurge.
Results:	See table 4-1. Crop tolerance and weed control ratings 5 weeks after preemergence herbicide applications, Waimanalo Experimental Farm, Experiment No. 4.

Discussion and Summary:

Crop tolerance—A slight reduction in the length of cucumber vines was found at the high rate of Sinox PE; no injury was detected with the remaining treatments. Shortly after germination the watermelon cotyledon margins turned upward in the Na PCP (sodium pentachlorophenate) treatments; thereafter excellent crop growth occurred as evidenced by vine measurements. All other chemicals resulted in varying degrees of injury to

watermelons. The injury to watermelons at the high rate of Alanap merits consideration.

Weed control—Alanap gave excellent control of all weed species up to the termination of the experiment at 7 weeks. Vegadex controlled all weeds except popolo. Na PCP at both rates and Sinox PE at the high rate resulted in near acceptable weed control.

Table 4-1. Crop tolerance and weed control ratings five weeks after preemergence herbicide applications, Waimanalo Experimental Farm, Experiment No. 4

Treatment (pounds per acre)	Crop Tolerance (Jan. 2)[1]				Weed Control Rating[2] (Jan. 2)
	Length of vine (inches)		No. of nodes per vine		
	Cucumber	Watermelon	Cucumber	Watermelon	
1. Check	27.8	31.5	10.7	12.3	1.3
2. Alanap 3 lb.	25.5	22.0	10.1	10.1	4.6
3. Alanap 4 lb.	26.0	21.0	10.3	10.1	4.4
4. Alanap 5 lb.	27.8	11.8	10.2	8.7	4.9
5. Sinox PE 3 lb.	26.3	24.8	10.6	10.8	3.5
6. Sinox PE 4 lb.	23.3	26.0	9.8	10.8	3.7
7. Na PCP 17 lb.	30.8	29.7	11.3	11.8	3.9
8. Na PCP 22 lb.	27.8	29.8	10.6	12.2	4.1
9. Vegadex 4 lb.	30.0	25.5	11.0	10.8	4.3
10. Vegadex 6 lb.	28.3	26.5	10.8	11.8	4.2
L.S.D. 5% (1%)					0.6(0.8)

[1]Crop tolerance—All values an average of 4 replications except cucumbers—Vegadex 4 lb. and 6 lb., watermelons—Alanap 5 lb., Na PCP 17 lb., and Vegadex 6 lb., an average of 3 replications. Statistical analyses not completed for crop tolerance because of missing plots resulting from snail damage and damping off.

[2]Weed rating scale: 1—no control, 2—slight, 3—fair, 4—good (commercially acceptable), 5—complete control.

EXPERIMENT NO. 5

(Permanent file copy WC-12)
Watermelon Trial
Waimanalo Experimental Farm Field A-3

Watermelon variety:	Charleston Gray.
Soil:	Waimanalo silty clay.
Experimental design:	Randomized complete block, 4 replications, plot size 5 ft. × 45 ft. (8 hills).
Experimental procedure:	Field preparation April 24, 1962; Seed sown April 27 (Treatments No. 2 and 3 sown on May 3); Treatment applications–Preemergence to the crop April 27, post-emergence to the crop at vining May 31.
Climatic conditions:	*Rainfall (over .10 inch):* April 26–.96 inch, May 3–.11, 4–.14, 5–1.02, 8–.21, 15–.37, June 1–.22, July 9–.11.
	Irrigation: Furrow irrigated on May 11, 18, 23, 28, June 4, 8, 15, 22, 25, 29, July 6, 13, 20, 27.
Weed species:	Most prevalent: *grasses*–wiregrass, sandbur; *broadleaves*–smooth amaranth spp., pigweed (purslane).
	Trace amounts: *broadleaves*–garden spurge, spiny amaranth.
Results:	See table 5-1. Watermelon tolerance and weed control response to the herbicides, Waimanalo Experimental Farm, Experiment No. 5.

Discussion and Summary:

Watermelon tolerance–Vine measurements showed that the watermelons were tolerant to Alanap and Na PCP treatments. Although not significantly different, there were indications that all of the chemicals reduced fruit size. Unfortunately, total yield data were not recorded, hence the indicated reduction in fruit yield cannot be evaluated.

Weed control—The weed control with Na PCP was poor in the irrigation furrow and excellent on the shoulders. Alanap resulted in commercially acceptable control of wiregrass, sandbur, smooth amaranth, and purslane.

Table 5-1. Watermelon tolerance and weed control response to the herbicides, Waimanalo Experimental Farm, Experiment No. 5

Treatment (pounds per acre)	Crop Tolerance		Weed Control Rating[1] (May 22)			
	Length of vine in inches (June 12)	No. of fruits/plot 10 inches in length and greater (Aug. 8)	Grasses		Broadleaves	
			Furrow	Shoulder	Furrow	Shoulder
1. Check, uncultivated	41.3	6.8	2.0	2.8	1.5	2.5
2. Check, cultivated [2]	39.5	11.3	2.0	2.5	1.0	1.8
3. Alanap 4 lb.	28.0	10.8	2.8	4.8	3.5	4.8
4. Alanap 3 lb.	19.0*	7.0	3.3	5.0	4.3	5.0
5. Alanap 4 lb.	39.0	7.0	3.8	5.0	4.8	5.0
6. Alanap 4 lb. + Alanap 4 lb. liquid at vining	33.5	8.8	3.8	4.8	4.0	5.0
7. Alanap 4 lb. + Alanap 4 lb. granular at vining	35.3	7.5	4.0	5.0	4.5	5.0
8. Na PCP 15 lb.	54.8	9.0	2.3	4.5	1.8	4.5
9. Na PCP 20 lb.	36.0	8.8	2.0	4.0	2.8	5.0
L.S.D. 5% (1%)	20.2(27.4)	n.s.	1.2(1.7)	0.9(1.3)	1.6(2.2)	1.0(1.4)

[1]Weed rating scale: 1—no control, 2—slight, 3—fair, 4—good (commercially acceptable), 5—complete control.

[2]Treatments No. 2 and 3 resown 6 days after treatment application.

*Significantly different from the cultivated check at the 5% level (**1% level).

EXPERIMENT NO. 6

(Permanent file copy WC-26)
Watermelon Trial
Waimanalo Experimental Farm Field C-3

Watermelon varieties:	Black Seeded Chilean and Charleston Gray.
Soil:	Waimanalo silty clay.
Experimental design:	Randomized complete block, 4 replications, split-plot arrangement of treatments—Main plots 10 formulations, subplots 2 varieties. Subplot dimensions 5 ft. × 20 ft. (8 hills).
Experimental procedure:	Field preparation October 25, 1962; Seed sown October 26; Treatment applications—Preemergence to the crop October 27, postemergence to the crop at vining November 20.
Climatic conditions:	*Rainfall (over .10 inch):* December 5—.10 inch, 10—.30. *Irrigation:* Furrow irrigated on November 2, 9, 14, 19, 21, 26, 30, and December 3.
Weed species:	Most prevalent: *grass*—wiregrass; *broadleaves*—spiny amaranth, pigweed (purslane), popolo.
Results:	See tables 6-1 (Watermelon tolerance) and 6-2 (Weed control).

Discussion and Summary:

Watermelon tolerance—Vine length measurements of the watermelons showed that no injurious effects resulted from the use of the preemergence sprays. The liquid formulation of Alanap applied at vining caused a greater reduction in vine length than the granular formulation. No differences were found in the number of nodes per vine for all treatments. No significant interaction was found between crops and formulations.

Weed control—Wiregrass, spiny amaranth, purslane, and popolo were controlled by the Na PCP treatment and the preemergence plus vining treatment of Alanap. The PCP mix and Vegadex resulted in poor to fair control of popolo. Vegadex and Na PCP were more effective in controlling wiregrass and purslane than the PCP mix and Alanap when used as a spray at sowing time.

Table 6-1. Watermelon tolerance to the herbicides, Waimanalo Experimental Farm, Experiment No. 6

Treatment (pounds per acre)	Watermelon Tolerance (Dec. 6)			
	Length of vine in inches		No. of nodes per vine	
	Black Seeded Chilean	Charleston Gray	Black Seeded Chilean	Charleston Gray
1. Check, uncultivated	65.2	63.4	20.9	19.8
2. Check, cultivated	61.3	66.0	19.7	20.8
3. Alanap 3 lb.	65.5	58.8	20.6	19.3
4. Alanap 4 lb.	57.6	60.3	19.6	18.4
5. Vegadex 4 lb.	69.1	65.5	21.4	20.5
6. Vegadex 6 lb.	57.1	68.4	18.9	20.3
7. Alanap 4 lb. + Alanap 4 lb. spray at vining	47.4**	52.0*	19.8	20.2
8. Alanap 4 lb. + Alanap 4 lb. granular at vining	54.9	62.5	19.3	20.0
9. Na PCP 22 lb.	63.8	61.7	20.7	20.2
10. PCP 4 lb. + 55 AR oil 6 gal. + Emulsifier + water	60.5	66.0	20.1	20.6
L.S.D. 5% (1%)	9.0(12.0)	9.0(12.0)	n.s.	n.s.

*Significantly different from the cultivated check at the 5% level (**1% level).

Table 6-2. Weed control response to the herbicides, Waimanalo Experimental Farm, Experiment No. 6

Treatment (pounds per acre)	Weed Rating (Dec. 11)[1, 2]			
	Wiregrass	Spiny Amaranth	Pigweed (Purslane)	Popolo
1. Check, uncultivated	1.0	1.3	1.0	1.5
2. Check, cultivated	2.3	2.5	2.3	3.5
3. Alanap 3 lb.	3.3	4.3	2.8	3.8
4. Alanap 4 lb.	3.0	4.8	2.8	3.8
5. Vegadex 4 lb.	3.8	5.0	4.8	3.5
6. Vegadex 6 lb.	4.3	4.5	4.5	3.5
7. Alanap 4 lb. + Alanap 4 lb. spray at vining	4.0	5.0	4.8	4.8
8. Alanap 4 lb. + Alanap 4 lb. granular at vining	4.8	5.0	4.8	5.0
9. Na PCP 22 lb.	5.0	5.0	4.5	5.0
10. PCP 4 lb. + 55 AR oil 6 gal. + Emulsifier + water	1.3	1.8	1.3	2.3
L.S.D. 5% (1%)	0.8(1.1)	0.7(1.0)	0.9(1.2)	1.0(1.3)

[1]Weed rating scale: 1–no control, 2–slight, 3–fair, 4–good (commercially acceptable), 5–complete control.

[2]One weed rating recorded per main plot; therefore, the analysis of variance was computed as a randomized complete block rather than a split-plot arrangement of treatments.

EXPERIMENT NO. 7

(Permanent file copy WC-11)
Watermelon Trial
Poamoho Experimental Farm Upper-Field E

Watermelon variety:	Black Seeded Chilean.
Soil:	Wahiawa silty clay loam.
Experimental design:	Randomized complete block, 4 replications, plot size 10 ft. × 45 ft. (4 hills).
Experimental procedure:	Field preparation April 16, 1962; Date of sowing and transplanting (1 true leaf showing) April 19; Treatment applications–Broadcast spray on April 19, post-emergence to the crop at vining May 17.
Climatic conditions:	*Rainfall (over.10 inch):* April 17–.18 inch, 20–.12, 25–2.10, May 4–.11, 5–.17, 7–1.27, 9–.40, 15–.17, 17–.10, 24–.10, June 1–.58, 18–.25, 19–.30, July 11–.15. *Irrigation:* Furrow irrigated when necessary.
Weed species:	Most prevalent: *grass*–wiregrass; *broadleaves*–pigweed (purslane), smooth amaranth spp. Trace amounts: *grass*–lovegrass; *broadleaves*–richardia, spiny amaranth.
Results:	See table 7-1. Watermelon tolerance and weed control response to the herbicides, Poamoho Experimental Farm, Experiment No. 7.

Discussion and Summary:

Watermelon tolerance–A comparison of the treatments applied to the seed crop shows that the weight of fruit harvested per plot was greatly reduced with all treatment combinations. In general, the vine measurements also showed the adverse effect of the herbicides. Similarly, the Alanap sprayed over the transplanted watermelons reduced the length of vines and

yield per plot to a limited extent when compared to either check. It is interesting to note that the transplanted watermelons produced no yield advantages over the direct-seeded crop.

Weed control—The control of wiregrass was not commercially acceptable with either Alanap or Na PCP; nevertheless, the purslane and smooth amaranth were easily controlled on the Wahiawa soil under the experimental conditions.

Table 7-1. Watermelon tolerance and weed control response to the herbicides, Poamoho Experimental Farm, Experiment No. 7

Treatment (pounds per acre)	Crop Tolerance: Vine Measurements (June 1) Length of vines in inches	Crop Tolerance: Vine Measurements (June 1) No. of nodes per vine	Total Yield Data: No. of fruits per plot	Total Yield Data: Wt. of fruits (pounds) per plot	Weed Control Rating in Furrows (May 11)[1] Grasses	Weed Control Rating in Furrows (May 11)[1] Broadleaves
1. Check (seed)[2]	76.8	22.8	14.8	240.6	1.3	1.3
2. Check (transplants)	94.8	29.5	14.3	229.3	1.0	1.0
3. Alanap 4 lb. (transplants)	68.3	25.0	10.5	165.9	3.3	4.3
4. Alanap 3 lb.	59.0**	19.3*	9.8	148.8*	3.5	4.3
5. Alanap 4 lb.	62.8*	21.5	10.0	123.4**	3.3	4.5
6. Alanap 4 lb. + Alanap 4 lb. spray at vining	57.8*	22.5	9.5	153.0*	3.3	4.5
7. Alanap 4 lb. + Alanap 4 lb. granular at vining	70.8	21.5	9.3	147.6*	3.5	4.8
8. Na PCP 17 lb.	73.0	24.0	12.8	148.6*	3.5	4.0
L.S.D. 5% (1%)	12.4(16.9)	3.4(4.6)	n.s.	77.7(105.7)	0.8(1.1)	0.6(0.9)

[1]Weed rating scale: 1—no control, 2—slight, 3—fair, 4—good (commercially acceptable), 5—complete control.

[2]Treatment No. 1 a check for Treatments No. 4 to 8; Treatment No. 2 a check for Treatment No. 3.

*Significantly different from the check (seed) at the 5% level (**1% level).

EXPERIMENT NO. 8

(Permanent file copy WC-16)
Watermelon Trial
Poamoho Experimental Farm Mid-Field E

Watermelon varieties:	Black Seeded Chilean and Charleston Gray.
Soil:	Wahiawa silty clay loam.
Experimental design:	Randomized complete block, 4 replications, plot size 10 ft. × 45 ft. (4 hills). Factorial arrangement of treatments—2 varieties × 4 formulations.
Experimental procedure:	Field preparation June 25, 1962; Seed sown June 27; Treatment applications—Preemergence to the crop June 28, postemergence to the crop at vining August 6.
Climatic conditions:	*Rainfall (over .10 inch):* June 19—.30 inch, July 11—.15, 12—.17, August 1—.19, 10—.10, 26—.10.
	Irrigation: Furrow irrigated when necessary.
Weed species:	Most prevalent: *grass*—wiregrass; *broadleaf*—pigweed (purslane).
	Trace amounts: *grasses*—lovegrass, sandbur; *broadleaves*—spanish needle, smooth amaranth spp.
Results:	See tables 8-1 (Watermelon tolerance) and 8-2 (Weed control).

Discussion and Summary:

Watermelon tolerance—The final yield estimate made by measuring the watermelons with diameters greater than 6 inches showed that Alanap was safe to use as a preemergence and postemergence spray on the test crop. However, the vine and node measurements indicated that Charleston Gray was more sensitive to the herbicides than the commonly used Black Seeded Chilean variety.

Weed control—Alanap did not control the weeds in this experiment. The dry conditions which prevailed for the duration of the experiment were believed to be largely responsible for the limited weed control. These results are often experienced in the Islands when preemergence herbicides are applied to furrow-irrigated crops in dry weather.

Table 8-1. Watermelon tolerance to the herbicides, Poamoho Experimental Farm, Experiment No. 8

Treatment (pounds per acre)	Watermelon Tolerance					
	Length of vines in inches (July 26)		No. of nodes per vine (July 26)		No. of fruits per plot 6 inches in length (Sept. 21)	
	Black Seeded Chilean	Charleston Gray	B.S.	C.G.	B.S.	C.G.
1. Check	29.0	34.1	8.9	9.9	8.9	13.0
2. Alanap 4 lb.	29.4	20.4	9.5	7.4	13.3	11.8
3. Alanap 4 lb. + Alanap 4 lb. spray at vining	33.0	20.5	10.0	7.1	17.3	10.5
4. Alanap 4 lb. + Alanap 4 lb. granular at vining	29.8	24.8	9.2	8.1	15.3	13.8
L.S.D. 5% (1%)	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

Table 8-2. Weed control response to the herbicides, Poamoho Experimental Farm, Experiment No. 8

Treatment (pounds per acre)	Weed Rating (July 26)[1]			
	Furrow		Shoulder	
	Grasses	Broadleaves	Grasses	Broadleaves
1. Check	1.5[2]	1.5	1.9	2.0
2. Alanap 4 lb.	2.3	2.9	1.9	2.0
3. Alanap 4 lb. + Alanap 4 lb. spray at vining	2.0	2.8	2.3	2.5
4. Alanap 4 lb. + Alanap 4 lb. granular at vining	2.3	3.1	2.9	3.0
L.S.D. 5% (1%)	n.s.	0.9(1.3)	n.s.	n.s.

[1]Weed rating scale: 1–no control, 2–slight, 3–fair, 4–good (commercially acceptable), 5–complete control.

[2]The weed data were computed on the basis of having 8 replications per treatment.

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